



# Testing concrete —

## Part 117: Method for determination of tensile splitting strength

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Association of County Councils	Federation of Civil Engineering Contractors*
Association of District Councils	Gypsum Products Development Association
Association of Metropolitan Authorities	Institute of Quarrying
Autoclaved Aerated Concrete Products Association	Institution of Civil Engineers*
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The organizations marked with an asterisk in the above list, together with the following, were directly represented on the Technical Committee entrusted with the preparation of this British Standard:

British Civil Engineering Test Equipment Manufacturers' Association	Greater London Council
Electricity Supply Industry in England and Wales	Institute of Concrete Technology
	Coopted member

This British Standard, having been prepared under the direction of the Cement, Gypsum, Aggregates and Quarry Products Standards Committee, was published under the authority of the Board of BSI and comes into effect on 31 January 1983

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The following BSI references relate to the work on this standard:  
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## Foreword

This Part of this British Standard, prepared under the direction of the Cement, Gypsum, Aggregates and Quarry Products Standards Committee, is a revision of clause 7 of BS 1881-4:1970. Together with Parts 115, 116, 118, 119 and 120, this Part of BS 1881 supersedes BS 1881-4:1970 which is withdrawn.

This Part of this standard describes one procedure for the determination of tensile splitting strength, with the option of using one of two sets of apparatus. Use of the procedure with one set of apparatus is derived from ISO 4108 which gives a tensile splitting strength test for cylindrical, cubic and prismatic specimens. Use of the procedure with the other set of apparatus is for cubic and prismatic specimens. Using the procedure with the alternative sets of apparatus cannot be expected to give equivalent results.

A typical estimate of repeatability for the test on 150 mm diameter  $\times$  300 mm long cylindrical specimens only is included. No estimate is given for other specimens or for reproducibility. Reference should be made to BS 5497-1 for further information on the determination of repeatability and reproducibility.

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### Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 6, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

## 1 Scope

This Part of this British Standard describes the method for the determination of the indirect tensile splitting strength of cylindrical, cubic and prismatic concrete test specimens.

NOTE The titles of the publications referred to in this Part of this standard are listed on the inside back cover.

## 2 Definitions

For the purposes of this Part of this standard the definitions given in BS 5328 and BS 5497-1 apply.

## 3 Apparatus

**3.1 General.** Either apparatus A<sup>1)</sup> for splitting cylindrical, cubic and prismatic specimens or alternatively apparatus B for splitting cubic and prismatic specimens shall be used.

### 3.2 Components of apparatus A and apparatus B

**3.2.1 Testing machine.** The testing machine shall comply with BS 1881-115.

**3.2.2 Jig.** Suitable jigs are shown in Figure 1. The jig and/or the machine shall have a device to position the jig correctly on the lower platen, with the specimen central.

### 3.3 Components of apparatus A

**3.3.1 Packing strips.** Use hardboard packing strips between the specimen and jigs or steel loading pieces. Packing strips shall be of oil tempered grade hardboard complying with BS 1142 and shall be used only once. They shall have the following dimensions [see Figure 1 (a) and Figure (b)].

width:	$a = 15 \pm 2$ mm;
thickness:	$t = 4 \pm 1$ mm;
length:	greater than the length of the line of contact of the test specimen.

**3.3.2 Steel loading pieces.** Place a steel loading piece between the platen of the machine and the hardboard packing strip. This piece shall not be shorter than the specimen. For cylindrical specimens it shall be of rectangular cross-section. For cubic and prismatic specimens, it shall be a section of a cylinder, with a radius of 75 mm, so that the load is applied along a line on the surface of the specimen [see Figure 1 (a) and Figure (b)]. This loading piece can be incorporated within the jig. The tolerances on the dimensions shall be as specified in 3.5.

### 3.4 Components of apparatus B

**3.4.1 Steel loading pieces.** Steel loading pieces shall be auxiliary platens incorporating steel strips with the following dimensions [see Figure 2 (c)]:

width:	$a = 6 \pm 1$ mm for 150 mm size specimens, $4 \pm 1$ mm for 100 mm size specimens;
thickness:	$t = 4 \pm 1$ mm;
length:	not less than the length of the line of contact with the test specimen.

The tolerances on the dimensions shall be as specified in 3.5.

**3.5 Tolerances.** The steel loading pieces specified in 3.3.2 and 3.4.1 shall have the flatness, parallelism and surface requirements along the length of the strips within the tolerances for auxiliary platens given in BS 1881-115.

The steel loading pieces shall be replaced when the dimensions are out of tolerance or they are seriously damaged or pitted along the contact face.

## 4 Test specimens

**4.1 Sampling.** Sampling of the concrete shall be carried out in accordance with BS 1881-101 or BS 1881-125.

**4.2 Preparation.** Test specimens shall be made in moulds cured and stored in accordance with the relevant Parts of this standard.

NOTE Cylindrical test specimens of 150 mm diameter  $\times$  150 mm long are preferred. For cubical and prismatic specimens, the cross section dimension of 150 mm is preferred.

**4.3 Mass.** Weigh each specimen, as-received or saturated, in accordance with BS 1881-114.

**4.4 Dimensions.** Check the nominal dimensions and take measured dimensions of each specimen in accordance with BS 1881-114.

**4.5 Density.** Determine the density of each specimen in accordance with BS 1881-114.

## 5 Procedure

**5.1 Preparation for testing.** Wipe clean the bearing surfaces of the testing machine, of the steel loading pieces and of the packing strips; remove any loose material from the surfaces of the test specimen which are to be in contact with the packing strips.

<sup>1)</sup> Apparatus A is based on that given in ISO 4108.

## 5.2 Positioning of the test specimen (see Figure 1).

Place the test specimen in the centring jig with packing strips and/or loading pieces carefully positioned along the top and bottom of the plane of loading of the specimen. Then place the jig in the machine so that the specimen is located centrally. In the case of prismatic and cubic specimens, the load shall be applied on the moulded faces in such a way that the fracture plane will cross the trowelled surface (see Figure 2). Ensure that the upper platen is parallel with the lower platen with cylindrical specimens.

**5.3 Loading.** Without shock, apply and increase the load continuously at a nominal rate within the range 0.02 N/(mm<sup>2</sup> s) to 0.04 N/(mm<sup>2</sup> s). Maintain the rate, once adjusted, until failure. On manually controlled machines as failure is approached the loading rate will decrease; at this stage operate the controls to maintain as far as possible the specified loading rate. Record the maximum load applied to the specimen. The rate of increase of load may be calculated from the formula:

$$(0.02 \text{ to } 0.04) \times \frac{\pi}{2} \times l \times d \text{ N/s}$$

## 6 Calculation and expression of results

**6.1 Calculation and expression of results.** The tensile splitting strength  $\sigma_{ct}$  in N/m<sup>2</sup> is given by the formula:

$$\sigma_{ct} = \frac{2F}{\pi \times l \times d}$$

where

- $F$  is the maximum load (in N);
- $l$  is the length of the specimen as shown in Figure 2 (in mm);
- $d$  is the cross-sectional dimension of the specimen as shown in Figure 2 (in mm).

Express the tensile splitting strength to the nearest 0.05 N/mm<sup>2</sup>.

**6.2 Precision.** For pairs of 150 mm diameter  $\times$  300 mm long cylinders, made from the same sample, cured in similar conditions and tested in accordance with this Part of this standard, the repeatability expressed as a percentage of the mean of the two strengths obtained, is 18 % at the 95 % probability level (see BS 5497-1).

## 7 Test report

**7.1 General.** The report shall affirm that the tests were made in accordance with this Part of this standard. The report shall also state whether or not certificates of sampling, specimen preparation and curing are available. If available, a copy of each certificate shall be provided.

### 7.2 Information to be provided by the producer of the test specimens

**7.2.1 Mandatory information.** The following information shall be provided by the producer of the test specimens for inclusion in the test report:

- a) date, time and place of sampling and sample identity number;
- b) time and place of making specimens;
- c) number and nominal size of specimens;
- d) method of compaction (hand or vibration) including type of equipment used;
- e) identification numbers of specimens;
- f) name of supplier of specimens;
- g) required age of the specimens at the time of testing;
- h) conditions of curing and storage.

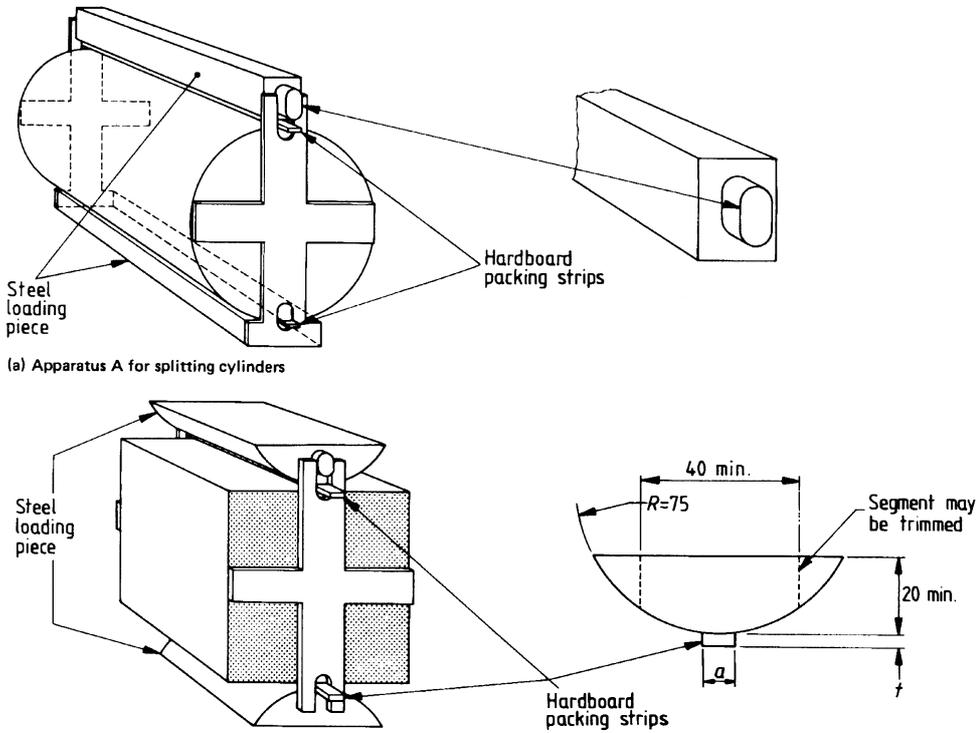
**7.2.2 Optional information.** If requested, the following information shall be provided by the producer of the test specimens for inclusion in the test report:

- a) name of project and place where concrete used;
- b) name of supplier and source of concrete;
- c) date and time of production of concrete or delivery to site;
- d) specification of concrete mix (e.g. strength grade);
- e) consistence of the sample;
- f) air content of the sample (if air-entrained).

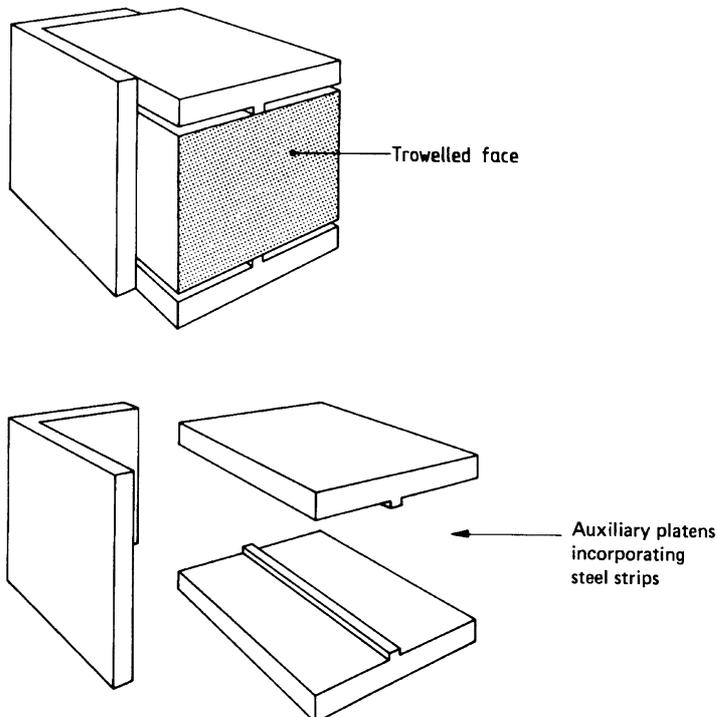
**7.3 Information to be provided by the test laboratory.**

The following information shall be provided by the test laboratory for inclusion in the test report:

- a) identification of the specimen;
- b) checked nominal or measured dimensions of the specimen;
- c) date of receipt of the specimen at the laboratory;
- d) condition of the specimen when received (include poor compaction, honeycombing or bad dimensions);
- e) description of treatment to remove fins;
- f) conditions of curing or storage at the laboratory;
- g) moisture condition at testing (saturated or moist);
- h) date of test;
- i) age of the specimen at test;
- j) mass of the specimen (as-received or saturated);
- k) density of the specimen (as-received or saturated and the method of determining the volume);
- l) maximum load at failure;
- m) tensile splitting strength;
- n) appearance of concrete and type of fracture if these are unusual;
- o) certificate that the test has been carried out in accordance with this Part of this standard;
- p) other remarks.



(b) Apparatus A for splitting cubes and prismatic specimens



(c) Apparatus B for splitting cubes and prismatic specimens

Figure 1 — Suitable jigs for the tensile splitting strength test

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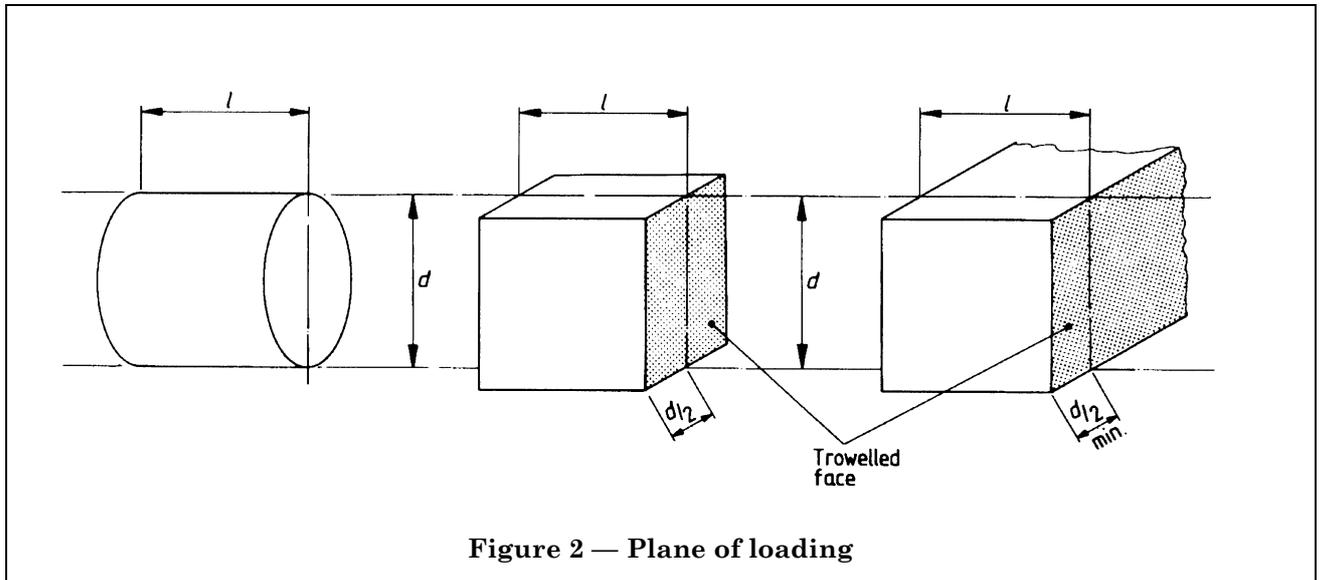


Figure 2 — Plane of loading



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## Publications referred to

BS 1142, *Fibre building boards.*

BS 1881, *Methods of testing concrete.*

BS 1881-101, *Methods for sampling fresh concrete.*

BS 1881-114, *Methods for determination of density of hardened concrete.*

BS 1881-115, *Specification for compression testing machines for concrete.*

BS 1881-125, *Methods for mixing and sampling fresh concrete in the laboratory.*

BS 5328, *Methods for specifying concrete, including ready-mixed concrete.*

BS 5497, *Precision of test methods.*

BS 5497-1, *Guide for the determination of repeatability and reproducibility for a standard test method.*

ISO 4108-1980, *Concrete — Determination of tensile splitting strength of test specimens<sup>2)</sup>.*

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<sup>2)</sup> Referred to in the foreword only.

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